UNIVERSITI TEKNOLOGI MARA

EFFICIENT K-COVERAGE SCHEDULING ALGORITHMS FOR WIRELESS SENSOR NETWORKS

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AUTHOR'S DECLARATION

I declare that the work of this thesis was carried out in accordance with the regulation of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Sensors are tiny devices, which consume low power and are inexpensive; they are used in many applications, such as, military surveillance, target tracking, forest-fire alarm. Many applications require k-coverage network to ensure the quality of the monitored area, where every single point is assured to be concurrently covered by a minimum of k sensors. Meanwhile, the network that provides more than the required k-coverage degree does not enhance the performance, but just increases the number of working sensors, and shortens the network lifetime. Preserving the requested k-coverage for Wireless Sensor Networks, while prolonging the network lifetime with a small computation cost, is a major challenge. This research demonstrates distributed and energy-efficient k-coverage scheduling algorithms that preserve the required k-coverage and prolong the network lifetime. An efficient k-coverage algorithm for sensors with fixed sensing range (Maximum Layers Scheduling algorithm - MLS) is demonstrated. MLS efficiently builds maximum number of layers, where, each layer consists of a disjoint set of working sensor nodes that conserve 1-coverage for the whole monitored area, and 1-connection that guarantees each layer is connected, and can individually deliver the data reporting to the base station. Moreover, MLS competently schedules the layers to conserve the required k-coverage degree, distribute the power consumption among sensors, and prolong the system lifetime. Experimental results show that, the MLS algorithm minimizes the average number of active sensors and the average coverage degree, and prolongs the network lifetime, compared to two popular k-coverage algorithms. Furthermore, MLS efficiently reduces the computation complexity and distributes the energy expenditure among sensors in the network. The second algorithm demonstrated in this study is Dynamic k-Coverage Scheduling Algorithm (D*k*CS), to prolong the network lifetime and preserve the required k-coverage in WSNs. The D*k*CS provides two types of k-coverage, static and dynamic. The static k-coverage provides k-coverage for all the monitored area, whereas, the Dynamic k-coverage provides k-coverage for intruder zone, while the rest of the monitored area is 1-covered. The network decides to run static or dynamic k-coverage scheduling, based on the coverage status of the layer, to ensure preserving the required k-coverage degree. Experimental results show that, the D*k*CS algorithm profoundly reduces the average number of active sensors, power consumption, and efficiently prolongs the network lifetime. The third demonstrated algorithm is a power aware k-coverage algorithm for WSNs with adjustable sensing range. The power consumption of this kind of sensor depends on the extent of the sensing radius. For this type of sensor, setting the coverage range to the minimum is necessary to decrease the energy consumption. Each sensor uses the least possible sensing range to provide coverage, without affecting the network k-coverage; on the other hand, the activated sensors are able to cover the same area, if the operational sensors are activated with their maximum sensing range. Experimental results show that, the proposed algorithm minimizes the sum of sensing energy cost of all sensors without affecting the network coverage, and also efficiently distribute the power among sensors in the network and prolong the network lifetime. Finally, a Dynamic k-Coverage Scheduling algorithm for WSNs with Adjustable sensing range (D*k*CSA) is demonstrated, where D*k*CS is implemented over MLSA to provide a dynamic scheduling algorithm for WSNs with adjustable sensing range capability. Experimental results show that, the D*k*CSA saving the network power, and prolonging the network lifetime, compared to D*k*CS.

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